AD-A151 013 PROPAGATION OF SOUND IN MATTER(U) CALIFORNIA UNIV LOS ANGELES DEPT OF PHYSICS I RUDNICK FEB 85 N00014-75-C-0246 1/1

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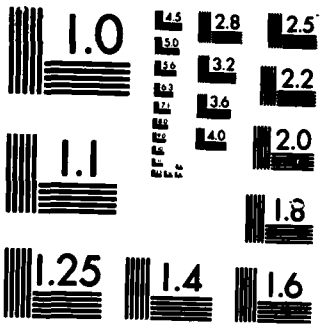

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9. PERFORMING ORGANIZATION NAME AND ADDRESS: Isadore Rudnick, P.I. Physics Dept., University of California, Los Angeles, Los Angeles, CA 90024	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: Program Element #61153N Project-Task #RR011-08-01 Work Unit #NR384-302
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18. SUPPLEMENTARY NOTES

None.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Solitons, subharmonics, quasiperiodic, phase lock porous media, 1st and 4th sound, superfluid, sound scattering.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

For Abstract see Annual Summary Report N00014-75-C-0246 1/1/84 - 12/31/84, Interim Summary Report N00014-67-A-0111-0019, N00014-69-A-0200-4014, N00014-75-C-0246 10/1/68 - 2/1/82 and Final Report Task Order 233(48) 1948 - 10/1/68.

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FINAL REPORT

N00014-75-C-0246

2/2/82 - 12/31/84

PROPAGATION OF SOUND IN MATTER

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Los Angeles, CA 90024

February 1985

The following Final Report covers the period February 2, 1982 to December 31, 1984 during which period research was conducted under Task Order N00014-75-C-0246. There is an Interim Summary Report covering N00014-67-A-0111-0019, N00014-69-A-0200-4014 and N00014-75-C-0246 between the dates 10/1/68 - 2/1/82. There also exists a Final Report covering research under Task Order 233(48) which is available on request.

LIST OF THOSE WHO RECEIVED SUPPORT ON ONR CONTRACTS FROM 2/2/82 TO 12/31.84 AND OBTAINED Ph.D. DEGREE IN PHYSICS INCLUDING THEIR PRESENT PROFESSIONAL POSITIONS.

1. John Stanley Marcus, Ph.D. December 1982, AMCOR Industries, Inc., 6100 Bandini Blvd., Los Angeles, CA 90040.

2. Michael Anthony Cabot, Ph.D. March 1983, TRW, El Segundo, CA.

LIST OF TECHNICAL REPORTS

1. John Stanley Marcus, "Persistent Currents in a Rotating Superleak Partially Filled with Superfluid Helium, December 1982.

2. Michael Anthony Cabot, "Non-linear Acoustics in a Dispersive Continuum: Random Waves, Radiation Pressure and Quantum Noise, March 1983.

LIST OF PUBLICATIONS

79. A Superfluid Waveguide Partially Packed with Superleak: Probing the Acoustic Properties of Porous Media, David Linton Johnson and I. Rudnick, J. of Low. Temp. Phys. 55, 455 (1984).

80. The Acoustics of Quantum Liquid Helium Near Absolute Zero, I. Rudnick, forthcoming in the Proceedings of the 11th International Congress on Acoustics, Paris, France, July 1983.

81. The Sounds of 4He-A Review, I. Rudnick, forthcoming the Proceedings of the 75th Jubilee Conference on He-4, St. Andrews, Scotland, August 1983.

82. Acoustic Properties of Superleaks Partially Saturated with Superfluid, I. Rudnick, G. Williams, and S. Baker, Proceedings of the Symposium on the Physics and Chemistry of Porous Media, AIP Conference Proceedings no. 107, p. 219 (1983).

83. Viscoelasticity and Zero Sound in Liquid 3He, I. Rudnick, forthcoming in the Proceedings of the IEEE Ultrasonics Symposium, Atlanta, Georgia, November 1983.

84. An Upper Division Student Laboratory Experiment which Measures the Velocity Dispersion and Nonlinear Properties of Gravitational Surface Waves in Water, Junru Wu and Isadore Rudnick, accepted for publication in the American Journal of Physics.

85. Observation of a Non-Propagating Hydrodynamic Soliton, Junru Wu, Robert Keolian, and Isadore Rudnick, Phys. Rev. Lett. 52, 1421 (1984).

86. Discovery of a Non-Propagating Hydrodynamic Soliton, Junru Wu, Robert Keolian, Isadore Rudnick, to be published in Proceedings of the International School of Physics, "Enrico Fermi","Frontiers of Physical Acoustics" 1984.

87. The Role of Phase Locking in Quasiperiodic Surface Waves in Liquid Helium and Water, Junru Wu, Robert Keolian, and Isadore Rudnick, to be published in Proceedings of the International School of Physics, "Enrico Fermi," "Frontiers of Physical Acoustics" 1984.

88. Smooth Modulation of Parametrically Driven Surface Waves in Liquid Helium-4, Robert Keolian and Isadore Rudnick, to be published in Proceedings of L.T. 17, Karlsruhe, Germany 1984.

89. Non-Linear Hydrodynamics and a One Fluid Theory of Superfluid He4, S. Putterman with P. Roberts, Physics Letters 89A, 444 (1982).

90. Classical Nonlinear Waves in Dispersive Nonlocal Media and the Theory of Superfluidity, S. Putterman with P. Roberts, Physica 117A, 369 (1983).

91. Comments on the Variational Principle and Superfluid Mechanics, Phys. Lett. 89A, 146 (1982), by S. Putterman.

92. Quantum Acoustics of Interacting Sound Waves, by S. Putterman, McGraw-Hill 1984 Yearbook of Science and Industry.

93. Enhancement of Diffusive Transfer by Periodic Pulsation between Dirichlet and Newmann Type Boundary Conditions, S. Putterman with R. Guibert, Applied Scientific Research 40, 271 (1983).

94. Energy Gap and Therman Properties of Selfsimilar Structures: an Application to Epoxy Resin, S. Putterman with P.F. Tua and R. Orbach, Phys. Lett. 98A, 357 (1983).

95. Impossibility of Observing Coherent Macroscopic Quantum Superposition: A New Law of Thermodynamics?, S. Putterman, Physics Letters 98A, 324 (1983).

96. Theory of Nonpropagating Hydrodynamic Solitons, A. Larraza and S. Putterman, Phys. Lett. 103A, 15, June 3, 1984.

97. Random Waves in a Classical Nonlinear Grassmann Field; I-Boltzmann Equation and Scalar Field Coupling, S. Putterman with P.H. Roberts, submitted for publication.

98. Random Waves in a Classical Nonlinear Grassmann Field; II-Scattering by Zero Point Noise and the Transition to Fermi Statistics, S. Putterman with P.H. Roberts, submitted for publication.

99. Theory of Nonpropagating Surface Wave Solitons, S. Putterman with A. Larraza, submitted for publication.

100. Amplitude Dependant Properties of a Hydrodynamic Soliton, J. Wu and I. Rudnick, submitted to Phys. Rev. Lett.

TECHNICAL DESCRIPTION OF RESEARCH COMPLETED

61. Discovery of a Non-Propagating Self-trapped Hydrodynamic Soliton.

We have discovered a hydrodynamic soliton which is trapped by its own unique properties. Theory and experiment are in excellent agreement.

62. Sound Propagation in Superfluid Helium with Partially Locked Normal Component: The Absorption and Dispersion of Scattered Sound.

When the normal component of superfluid helium is progressively locked by increasing the flow resistance of the superleak first sound becomes fourth sound and second sound becomes a non-propagating diffusive wave. The absorption and dispersion which accompany these transitions was studied experimentally and theoretically and good agreement is found. Multiple scattering occurs when fluid or fourth sound propagates in a superleak, and such systems offer an ideal opportunity to test scattering theories (Publ. 82). This is Steve Baker's Ph.D. thesis. We should be issuing a Technical Report in three or four months.

NOTES ON TECHNICAL DESCRIPTION OF RESEARCH COMPLETED

Item 50 in the Research Completed list is treated in publications 80 and 83.

Item 52 in Research Completed list is further developed in publications 87 and 88.

Items 35 and 38 in Research Completed list contains a description of an annulus partially packed with superleak and containing superfluid helium. This system has proved to have considerable utility and has been used to study persistent currents in bulk helium (Publ. 35), the trapping of persistent currents in superleaks (Publ. 38), persistent currents in films (Publ. 51). The theory of the acoustic modes of this system is developed in Publications 38, 41 and 79. Publication 79 has the most exact result.

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